

Claims

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1. A surgical suture delivery system comprising:  
a suture wrapped in a set of coils, said suture comprising a first end and a second end;  
a needle guide; and  
a needle slideably mounted in the needle guide to pass a portion of the suture through at least one tissue.
2. The invention of Claim 1 further comprising:  
a suture carrier comprising a line passing through at least one of the coils, said line comprising a first end and a second end.
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3. A surgical suture delivery system comprising:  
a suture having a partially tied knot comprising at least one loop, said suture comprising a first end and a second end;  
a needle guide; and  
a needle slideably mounted in the needle guide to pass a portion of the suture through at least one tissue.
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4. The invention of Claim 3 further comprising:  
a suture carrier comprising a line passing through the loop of the partially tied knot, said line comprising a first end and a second end.
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5. A surgical suture delivery system comprising;  
a tube comprising first and second legs and a bight portion arranged in a U-shape;  
a suture wrapped around both legs of the tube, said suture comprising a first end and a second end;  
25 a suture carrier comprising a line passing through at least part of the tube, said line comprising a first end and a second end.

6. A surgical suture delivery system comprising:  
a support element carrying a plurality of suture assemblies, each suture assembly comprising:

a suture wrapped in a set of coils, said suture comprising  
a first end and a second end;

7. The invention of Claim 6 wherein each suture assembly further comprises:

a suture carrier comprising a line passing through at least one of the coils, said line comprising a first end and a second end;

8. A surgical suture delivery system comprising:  
a support element carrying a plurality of suture assemblies, each suture assembly comprising:

a suture having a partially tied knot comprising at least one loop, said suture comprising a first end and a second end;

9. The invention of Claim 8 wherein each suture assembly further comprises:

a suture carrier comprising a line passing through the loop of the partially tied knot, said line comprising a first end and a second end.

10. A surgical suture delivery system comprising:  
a support element carrying a plurality of suture assemblies, each suture assembly comprising:

a tube comprising first and second legs and a bight portion arranged in a U-shape;

a suture wrapped around both legs of the tube, said suture comprising a first end and a second end;

a suture carrier comprising a line passing through at least part of the tube, said line comprising a first end and a second end.

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11. The invention of Claim 6, 8 or 10 wherein the suture delivery system further comprises a modular housing containing the support element and the suture assemblies, said modular housing forming a disposable unit.

12. The invention of Claim 11 further comprising:  
a needle guide carried by the housing;  
a needle slideably mounted in the needle guide; and  
an indexing mechanism coupled with the support element and operative to index successive ones of the suture assemblies into position adjacent the needle guide.

13. The invention of Claim 2, 4 or 5 further comprising:  
a first spool coupled with the first end of the suture; and  
a second spool coupled with the first end of the line.

14. The invention of Claim 7, 9 or 10 wherein each suture assembly further comprises:  
a first spool coupled with the first end of the respective suture;  
and  
a second spool coupled with the first end of the respective line.

15. The invention of Claim 1 wherein at least one of the coils is wrapped around a tube.

16. The invention of Claim 6 wherein at least one of the coils of each suture assembly is wrapped around a tube.

17. The invention of Claim 3 wherein at least one loop of the partially tied knot is wrapped around a tube.

18. The invention of Claim 8 wherein at least one loop of the partially tied knot of each suture assembly is wrapped around a tube.

19. The invention of Claim 1, 3 or 5 wherein the second end of the suture comprises an enlarged element configured to engage a point of a needle.

20. The invention of Claim 6, 8 or 10 wherein the second end of each suture comprises an enlarged element configured to engage a point of a needle.

21. The invention of Claim 2, 4 or 5 wherein the second end of the line carries a gripping element configured to grip the second end of the suture.

22. The invention of Claim 7, 9 or 10 wherein the second end of each line carries a gripping element configured to grip the second end of the suture.

23. The invention of Claim 1 or 3 wherein the suture delivery system further comprises:

a gripping element configured to grip the second end of the suture.

24. The invention of Claim 6 or 8 wherein each suture assembly further comprises

a gripping element configured to grip the second end of the suture.

25. The invention of Claim 23 further comprising:

a first spool coupled with the first end of the suture; and  
a second spool coupled with the gripping element.

26. The invention of Claim 24 wherein each suture assembly further comprises:

a first spool coupled with the first end of the respective suture;  
and

a second spool coupled with the gripping element.

27. The invention of Claim 15 or 17 wherein the tube comprises a frangible material disposed between the suture and the inside of the tube, said frangible material configured to rupture in response to tension on the suture, thereby allowing the suture to pass through the tube.

28. The invention of Claim 16 or 18, wherein the tube comprises a frangible material disposed between the suture and the inside of the tube, said frangible material configured to rupture in response to tension on the suture, thereby allowing the suture to pass through the tube.

29. The invention of Claim 5 or 10, wherein the tube comprises a frangible material disposed between the suture and the inside of the tube, said frangible material configured to rupture in response to tension on the suture, thereby allowing the suture to pass through the tube.

30. The invention of Claim 5 further comprising:  
a needle guide; and  
a needle slideably mounted in the needle guide to pass a portion of the suture through at least one tissue.

31. The invention of Claim 5 or 10 further comprising:  
a spacer positioned between the first and second legs.

32. The invention of Claim 1 or 6 further comprising:  
a spacer positioned between the coils.

33. A surgical suturing device comprising:  
a frame comprising an operating portion and a handle portion;  
a guide carried by the operating portion;  
a needle mounted to move in the guide between retracted and extended positions;  
at least one suture carried by the operating portion, said suture comprising a set of coils; and

at least one trimmer blade positioned near the guide to sever the suture.

34. A surgical suturing device comprising:  
a frame comprising an operating portion and a handle portion;  
a guide carried by the operating portion;  
a needle mounted to move in the guide between retracted and extended positions;  
at least one suture carried by the operating portion, said suture having a partially tied knot; and  
at least one trimmer blade positioned near the guide to sever the suture.

35. A surgical suturing device comprising:  
a frame comprising an operating portion and a handle portion;  
a guide carried by the operating portion;  
a needle mounted to move in the guide between retracted and extended positions;  
at least one suture carried by the operating portion, said suture comprising a set of coils; and  
an actuator carried by the handle portion and operatively coupled with the needle such that manual control of the actuator moves the needle between the retracted and the extended positions.

36. A surgical suturing device comprising:  
a frame comprising an operating portion and a handle portion;  
a guide carried by the operating portion;  
a needle mounted to move in the guide between retracted and extended positions;  
at least one suture carried by the operating portion, said suture comprising a partially tied knot; and

an actuator carried by the handle portion and operatively coupled with the needle such that manual control of the actuator moves the needle between the retracted and the extended positions.

37. The invention of Claim 33, 34, 35 or 36 wherein the needle comprises a point, and wherein the suture comprises an enlarged element configured to engage the point of the needle.

38. The invention of Claim 33 or 35 wherein the set of coils of the suture is positioned in alignment with the needle in the extended position.

39. The invention of Claim 34 or 36 wherein the loop of the partially tied suture is positioned in alignment with the needle in the extended position.

40. The invention of Claim 37 wherein the enlarged element comprises a recess configured to receive the point of the needle.

41. The invention of Claim 37 wherein the point of the needle comprises a notch configured to engage the suture.

42. The invention of Claim 33 or 35 wherein at least one of the coils is wrapped around a tube.

43. The invention of Claim 34 or 36 wherein at least one loop of the partially tied knot is wrapped around a tube.

44. The invention of Claim 42 wherein the tube comprises first and second legs and a bight portion arranged in a U-shape; and wherein the coils of said suture are wrapped around both legs of the tube;

45. The invention of Claim 33, 34, 35 or 36 wherein the suturing device further comprises a gripping element configured to grip the suture.

46. The invention of Claim 45 wherein the gripping element is included in a suture carrier, and wherein the suture carrier further comprises a line.

47. The invention of Claim 46 wherein said suture carrier is aligned with the needle in the extended position.

48. A method for tying a surgical suture, said method comprising:

- 5 (a) providing a suturing device comprising a handle at one end and at least one needle and at least one suture at the other end;
- (b) in response to at least one triggering event at the handle, performing the following acts at the other end of the suturing device:
- (b1) passing the needle and a portion of the suture through tissues to be held together;
- (b2) forming a knot in the suture with the suturing device; then
- (b3) tightening the knot with the suturing device.

49. The method of Claim 48 further comprising:

- (c) cutting the suture on both sides of the knot with the suturing device after (b).

50. The method of Claim 48 wherein the suturing device provided in (a) comprises a plurality of sutures, and wherein the method further comprises:

- 20 (c) moving a next one of the sutures into alignment with the needle after (b).

51. A method for tying a surgical suture, said method comprising:

- 25 (a) providing a suture delivery system comprising:
- a suture wrapped in a set of coils, said suture comprising a first end and a second end;
- a suture carrier comprising a line passing through at least one of the coils, said line comprising a first end and a second end;
- a needle guide; and
- a needle slideably mounted in the needle guide;



- (b) passing the second end of the suture with the needle through tissues to be secured together; then
- (c) gripping the second end of the suture with the suture carrier near the second end of the line; then
- (d) moving the second end of the suture through said at least one of the coils with the suture carrier; and then
- (e) tightening the first and second ends of the suture.

52. A method for tying a surgical suture, said method comprising:

- (a) providing a suture delivery system comprising:
  - a suture wrapped in a set of coils, said suture comprising a first end and a second end;
  - a gripping element configured to grip the second end of the suture;
  - a needle guide; and
  - a needle slideably mounted in the needle guide;
- (b) passing the second end of the suture with the needle through tissues to be secured together; then
- (c) passing the second end of the suture through said at least one of the coils with the needle; then
- (d) gripping the second end of the suture with the gripping element; and then
- (e) tightening the first and second ends of the suture.

53. A method for tying a surgical suture, said method comprising:

- (a) providing a suture delivery system comprising:
  - a suture having a partially tied knot comprising at least one loop, said suture comprising a first end and a second end;
  - a suture carrier comprising a line passing through the loop of the partially tied knot, said line comprising a first end and a second end;
  - a needle guide; and
  - a needle slideably mounted in the needle guide;

- (b) passing the second end of the suture with the needle through tissues to be secured together; then
- (c) gripping the second end of the suture with the suture carrier near the second end of the line; then
- 5 (d) moving the second end of the suture through the loop with the suture carrier; and then
- (e) tightening the first and second ends of the suture.

54. A method for tying a surgical suture, said method comprising:

- (a) providing a suture delivery system comprising:  
a suture having a partially tied knot comprising at least one loop, said suture comprising a first end and a second end;  
a gripping element configured to grip the second end of the suture;  
a needle guide; and  
a needle slideably mounted in the needle guide;
- (b) passing the second end of the suture with the needle through tissues to be secured together; then
- (c) passing the second end of the suture through the loop with the needle; then
- 20 (d) gripping the second end of the suture with the gripping element; and then
- (e) tightening the first and second ends of the suture.

55. The method of Claim 51 wherein the suture delivery system of (a) comprises a tube, and wherein the suture is wrapped around the tube.

25 56. The method of Claim 52, 53 or 54 wherein the suture delivery system of (a) comprises a tube, and wherein the suture is wrapped around the tube.

57. The method of Claim 55 wherein the tube provided in (a) comprises first and second legs and a bight portion arranged in a U-shape, and wherein the suture is wrapped around both legs of the tube.

58. The method of Claim 57 further comprising:

5 (f) placing at least one spacer between the bight portion and the suture and between the first and second legs prior to (d).

59. The method of Claim 51 or 52 further comprising:

(f) placing at least one spacer between the coils and the second end of the suture prior to (e).

60. The method of Claim 51 or 52 wherein (e) comprises:

(e1) pulling at least one of the ends of the suture to tighten a first loop of the suture but not a second loop of the suture; and then

(e2) pulling at least one of the ends of the suture to tighten the second loop of the suture.

61. The method of Claim 53 or 54 wherein (e) comprises:

(e1) pulling at least one of the ends of the suture to tighten a first loop of the suture but not a second loop of the suture; and then

(e2) pulling at least one of the ends of the suture to tighten the second loop of the suture.

62. The method of Claim 60 further comprising;

progressively reducing an effective width of the spacer during (e2).

63. The invention of Claim 55 wherein the tightening of (e) causes the suture to break through the tube.

64. The invention of Claim 56 wherein the tightening of (e) causes the suture to break through the tube.

65. The method of Claim 60 further comprising:

(e3) automatically initiating (e2) when tension in the first loop reaches a threshold value during (e1).

66. The method of Claim 61 further comprising:

(e3) automatically initiating (e2) when tension in the first loop reaches a threshold value during (e1).

67. The method of Claim 51, 52, 53 or 54 wherein (e) forms a knot in the suture, and wherein the method further comprises:

(g) cutting the suture on both sides of the knot after (e).

68. The method of Claim 51, 52, 53 or 54 wherein the suture delivery system provided in (a) comprises a plurality of sutures, and wherein the method further comprises:

(g) moving a next one of the sutures into alignment with the needle after (e).

69. A method for tying a surgical suture, said method comprising:

(a) providing a suturing device comprising a handle at one end and at least one needle and at least one suture at the other end;

(b) in response to a first triggering event at the handle, performing the following acts at the other end of the suturing device:

(b1) passing the needle and a portion of the suture through two tissues to be held together; then

(b2) forming at least first and second loops in the suture; and then

(b3) tightening the first loop;

(c) in response to a second triggering event at the handle, performing the following acts at the other end of the suturing device;

(c1) tightening the second loop; and then

(c2) cutting the suture on both sides of the second loop.

70. The method of Claim 69 wherein the suturing device provided in (a) comprises a plurality of sutures, and wherein (c) further comprises:

(c3) moving a next one of the sutures into alignment with the needle.

71. A method for tying a surgical suture, said method comprising:

(a) providing a suturing device comprising a handle at one end and at least one needle and at least one suture at the other end, each said suture comprising a partially tied knot comprising a second loop;

(b) in response to a first triggering event at the handle, performing the following acts at the other end of the suturing device:

(b1) passing the needle and a portion of the suture through two tissues to be held together; then

(b2) forming at least a first loop in the suture and then

(b3) tightening the first loop;

(c) in response to a second triggering event at the handle, performing the following acts at the other end of the suturing device;

(c1) tightening the second loop; and then

(c2) cutting the suture on both sides of the second loop.

72. The method of Claim 71 wherein the suturing device provided in (a) comprises a plurality of sutures, and wherein (c) further comprises:

(c3) moving a next one of the sutures into alignment with the needle.